Appendix H
Guide Specification for "Geodetic Quality" NAVSTAR Global Positioning System (GPS) Survey Receivers and Related Equipment/ Instrumentation

INSTRUCTIONS

H-1. General

This guide specification supersedes the USACE guide CW-01334.2, 21 June 1991, "Procurement of NAVSTAR Global Positioning System (GPS) Survey Receivers and Related Instrumentation/Equipment." This guide specification is intended for use in preparation and review of specifications for geodetic quality GPS survey instrumentation, equipment, and software. The equipment may be used in static or kinematic applications where centimeter-level applications are required. The GPS data may be post-mission processed to generate positions, or the data may be computed in real time, if the appropriate software and data link are used. This guide includes the technical requirements needed to develop formally advertised specifications.

H-2. Applicability

This guide applies to differential GPS (DGPS) survey systems that provide a three-dimensional baseline between two antennas to an accuracy of about 1 cm or better. Applications include establishing and/or extending precise engineering and construction control, creating digital elevation models, camera station positioning for aerial photogrammetry, hydrographic survey vessel positioning, and tidal/water surface measuring for civil works and military construction projects. This guide supports precise differential static, kinematic, pseudo-kinematic, stop-and-go, and on-the-fly survey modes, in both post mission processing and real time applications. This guide is not intended to support real-time GPS code tracking systems that provide meter-level accuracies for general positioning or navigation applications. (Note that the equipment designed to meet the geodetic needs are generally capable of also meeting the less stringent differential code applications but at much greater cost.) Refer to Appendix I for differential code based equipment to support general meter-level positioning and navigation applications.

H-3. Coverage

This guide follows the Uniform Contract Format for supply solicitations, as outlined in Part 14.201 of the Federal Acquisition Regulations (FAR).

a. This guide may be used for either direct bid solicitations or proposal request solicitations, depending on the complexity of the required system. Evaluation factors (Part IV, Section M) are provided for contracts involving a technical review of proposals. The use of a technical review is optional.

b. A sample "Supplies of Services and Prices" schedule is included in this guide for insertion in Part I, Section B of the contract. Technical performance requirements for a DGPS survey system are in Part I, Section C (Description/ Specifications). Other contract sections that require clauses specific to DGPS equipment are noted. Nontechnical supply contract clauses/provisions, which are incorporated in Parts I, II, III, and IV of the procurement specifications, should be developed by each respective Field Operating Activity (FOA) using appropriate FAR and supplemental guidance.

c. Continuing developments in GPS survey instrumentation and techniques mandate that these guide specifications be continuously evaluated by USACE commands to ensure they are technologically current.

H-4. References

The specification writer must be thoroughly familiar with the basic GPS operating functions (e.g., determining the optimum number and technical characteristics of GPS receivers, auxiliary support equipment and instrumentation, baseline reduction software, and network adjustment criteria) to define the technical requirement options contained in this guide. Additional guidance is found in the HQUSACE POLICY MEMORANDUM, Subject: "Acquisition and Use of Differential Global Positioning System (DGPS) Equipment for USACE Activities," dated 27 January 1994. Other topical information on DGPS is contained in EM 1110-2-1003 "Hydrographic Surveying."

H-5. DGPS System Requirements

This guide may be used to procure a complete "field-to-finish" DGPS survey system. This includes the six scheduled items in Section B: (1) GPS receivers, (2) a microcomputer system, (3) GPS baseline reduction software, (4) network adjustment software, (5) a data link for real time applications, and (6) onsite training. If desired, the system may also be configured to operate with the "On-The-Fly" software developed by USACE under the Dredging Research Program. Some vendors may also supply software providing similar capability. If GPS receivers are being added to an existing system or suite of equipment, then only item (1) above would be required in the solicitation, with other items deleted as necessary. Also note that, in

general, mixing receivers from different manufacturers may not work with all techniques and software.

H-6. Alternate Clauses/Provisions or Options

Alternate clauses/provisions throughout this guide specification are indicated by a single asterisk. This asterisk signifies that provisions that are not applicable to the particular procurement should be deleted. Clauses requiring insertion of descriptive material are indicated by an asterisk and in brackets (e.g., *[ ]). When a choice of items exists, they are normally contained in successive brackets.

H-7. Notes and Comments

General comments and instructions used in this guide are contained within asterisk blocks and highlighted in bold type. These blocked comments and instructions should be removed from the final contract.

H-8. Submittal For Review and Approval

If specifications for NAVSTAR GPS survey systems are required to be submitted to higher authority for review and approval, they shall include printed copies of this guide specification, as revised for the particular procurement action. Guidance on review requirements for GPS systems is contained in the HQUSACE POLICY MEMORANDUM, Subject: "Acquisition and Use of Differential Global Positioning System (DGPS) Equipment for USACE Activities," dated 27 January 1994.

Part I - The Contract Schedule

Section A

Solicitation/Contract Form

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NOTE: Include here Standard Form 33 (Solicitation, Offer and Award) or Standard Form 26 (Award/Contract), as applicable.

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Section B

Supplies or Services and Prices/Costs

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NOTE: The sample below represents a typical schedule for procurement of GPS instrumentation and related equipment. This schedule must be tailored based on the specific technical requirements outlined in Section C of the contract.

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Supplies/Services and Prices

Item No.	Description	Quantity	U/M	U/P	Amt
0001	Precise GPS survey receiver system, related equipment, software, data link, and other components, in accordance with the technical specifications found in Section C.	*[___]	EA	___	___

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add for RFP evaluation or if necessary

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* [Evaluation will be made on the basis of the technical data under the guidelines found in Section M. Failure to show compliance with the specifications will require rejection of the bid.]

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NOTE: The following items are included if a full "field-to-finish" differential GPS survey system is required. Alternately, selected items may be used if the solicitation is to upgrade or add to existing GPS equipment.

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0002	*[Micro-computer system, as specified in Section C.]		___		___	___	___

Item No.	Description	Quantity	U/M	U/P	Amt
0003	* [GPS baseline reduction software, as specified in Section C.]	___	___	___	___
0004	* [Network adjustment software, as specified in Section C.]	___	___	___	___
0005	* [Data link for real-time applications, as specified in Section C.]	___	___	___	___
0006	* [GPS receiver system, data reduction, processing and adjustment software training.]	___	___	___	___

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NOTE: Add other items to the schedule as necessary. These may include tripods, tribrachs, spare batteries, data storage devices, communication/modem devices, software/hardware for navigation (e.g., survey vessel positioning and guidance control). Hardware/software interface requirements to existing survey systems (e.g., hydrographic systems) may also be separately scheduled.

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Section C

Description / Specifications

C.1. General DGPS Description. The DGPS to be procured under this solicitation is intended for use in *[static and/or kinematic] positioning applications using the GPS carrier phase as the principle observable. The system will yield 3-dimensional vectors between a reference and "rover" station to an accuracy of *[10 mm + 2 ppm or better on baselines of 1 to 50 km when operating in a static mode] [and] *[3 cm or better on baselines up to 25 km when operating in a kinematic mode]. *[The system is intended to operate in real time with the incorporation of a communications link, as specified further in Section C of this solicitation.] *[The system will have the capability to resolve the initial integer cycle ambiguity in a robust manner, automatically, while the rover is constantly in motion, known as on-the-fly (OTF), with no more than 60 sec of data, on baselines up to 25 km in length.] *[The OTF ambiguity resolution software will operate in *[real time] *[and/or] *[post processing] applications]. *[The system procured under this solicitation will interface to, and operate with, the USACE OTF software distributed by the U.S. Army Topographic Engineering Center, ATTN: CETEC-TD-GS (OTF software), 7701 Telegraph Rd, Alexandria, Virginia 22315-3864.]

C.2. Receiver Requirements. Unless otherwise specified, the performance requirements given below shall be met by the GPS receivers in conjunction with the antenna assembly and antenna cable.

C.2.1. GPS Signal Levels. GPS receivers delivered shall acquire and track GPS signals and otherwise perform as specified herein, when the signal levels from GPS satellites incident at the antenna are within the range of minimum to maximum levels specified in ICD-PGS-200B-PR.

C.2.2. Cryptographic Keys. *[Unless otherwise specified,] GPS receivers shall perform as specified herein without requiring cryptographic keys, whether or not GPS selective availability (SA) and/or anti-spoofing (AS) are activated.

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NOTE: Two versions of C.2.3. are given. L1 only receivers are adequate for static geodetic survey operations. Robust kinematic operations and OTF ambiguity resolution requires more capable hardware observing the full wavelength L1 and full wavelength L2 carrier phase. Choose one of the two given C.2.3 appropriately.

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*[C.2.3. GPS Observables. The GPS receivers delivered shall provide, at a minimum, the following time-tagged observables: full L1 C/A code, L1 P-code, continuous full wavelength L1 carrier phase, L2 P-code, and continuous full wavelength L2 carrier phase.]

*[C.2.3. GPS Observables. The GPS receivers delivered shall provide, at a minimum, the following time-tagged observables: full L1 C/A code and continuous full wavelength L1 carrier phase.]

(1) Measurement Time Tags. Signal measurements (observables) shall be time tagged with the time of receipt of the signal referenced to the receiver clock. Time tags shall have a resolution of 1 μsec or better. Time tags shall be within 1 msec with respect to GPS time.

(2) Carrier Phase Accuracy. The receiver shall have L1 {*the following is required for OTF operation*} *[and l2 full wavelength] carrier-phase measurement accuracies of 0.75 cm (RMS) or better, exclusive of the receiver clock offset.

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NOTE: The following C.2.3. (3) is for OTF operation only.

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*[(3) Code Accuracy. The receiver shall have an L1 C/A-code phase measurement accuracy of 30 cm (RMS) or better, exclusive of receiver clock time and frequency offsets.]

C.2.4. Receiver Output. The GPS receiver shall be able to output the GPS observables as described in C.2.3. with a latency of less than 1 sec *[and, simultaneously, a differential code position and the timing information stated in 2.6]. The GPS receivers shall be able to output the information from the full GPS navigation message, as specified in ICD-GPS-200 REVB-PR. This shall include ephemeris data, almanac data, ionospheric parameters, and coordinated universal time (UTC) parameters. The UTC and ephemeris data shall be available by request or if a change has occurred in those parameters.

C.2.5. Receiver Data Rate. The GPS observable data described above shall be available at a minimum of a 1 Hz rate.

C.2.6. 1 Pulse Per Second (PPS) Output. GPS receivers delivered shall have a 1 PPS time strobe and its associated time tag. The 1 PPS pulse and time tag shall be accessible through a port (or ports) on the GPS receiver so that external system components can be time synchronized to UTC time.

C.2.7. Internal Receiver Testing. The receiver shall perform a self test and checks to detect electronic malfunctions and/or faulty data collection, including cycle slips. The receiver shall provide immediate *[audio] *[visual] notification of failures. The receiver shall perform any needed calibrations automatically.

C.2.8. Reinitialization. The receiver shall be capable of reinitializing itself and resume normal operation after a power interruption without operator assistance. The data collected by the GPS receiver shall not be lost due to power interruption but stored in the receiver or other archiving media.

C.2.9. Multiple Satellite Tracking. The receiver must be capable of tracking and observing all signals previously stated on a minimum of eight satellites simultaneously, each on an independent channel.

C.2.10. Operating Conditions. The GPS receivers delivered shall meet the following criteria:

(1) Successfully acquire and track unobstructed GPS satellites, visible 5 deg and higher above the horizon, in all weather conditions.

(2) Operate at humidity ranges of 0 to 100 percent.

(3) Operate within the temperature range of -20 ºC to +50 ºC.

*[(4) Be waterproof and able to operate in an ocean environment aboard open survey launches.]

*[(5) Operate in heavy rain, 50.8 mm/day (2 in./day).]

*[(6) Operate in fog.]

*[(7) Operate in and resist corrosion in salty air conditions.]

C.2.11. Receiver Power Requirements. The GPS receivers delivered shall meet the following criteria:

(1) Be self protecting from power surges, spikes, and reverse polarity.

(2) Allow the operator to switch power sources (AC, DC, or battery) while maintaining receiver operation and without loss of stored data.

(3) Provide a *[visual] *[audible] warning for low power.

(4) Be capable of operating using *[a battery pack] *[and] *[or] *[AC power] *[and] *[or] *[12-v DC] *[24-v DC] *[external DC power].

*[(5) The battery pack shall meet the following criteria:]

*[(a) Contain rechargeable battery/batteries which can operate the receiver for at least 3.5 hr on a single (re)charge.]

*[(b) Be *[either] *[internal] *[or] *[external] to the receiver.]

*[(c) Include all cables, hardware, etc. necessary to connect/install the battery pack. The batteries shall be water and dust tight and be protected from damage and inadvertent shorting of the terminals.]

*[(6) For operation using *[AC] *[and] *[external DC] *[power.]

*[(a) When operating under *[AC] *[or] *[DC] power, the unit shall be capable of simultaneously charging the battery pack. The battery pack shall power the receiver if the normal power supply is interrupted.]

*[(b) The AC power supply *[shall be internal] *[may be internal or external] to the receiver.]

*[(c) The power supply/battery charger shall provide all voltages necessary to operate the receiver and (re)charge the battery pack.]

*[(d) The power supply/battery charger shall be designed to automatically protect the battery pack from overcharging.]

*[(e) All cables and connectors needed to connect the power supply/battery charger to the power line *[and receiver] shall be included.]

*[(f) The AC power supply/battery charger shall operate from *[115-v] *[and 230-v] ac (±10 percent) *[50/] 60 Hz, single phase power.]

*[(g) The unit shall operate from external *[12-v DC] *[24-v DC] *[9 to 32-v DC] power.]

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NOTE: Not all manufacturers provide a battery that is internal to the receiver. Moving the battery pack external to the receiver does not affect the functioning; it is a matter of design. For example, doing this could substantially decrease the size of the unit. Different manufacturers have different setups for the batteries. The District is encouraged to know what will work best for them based upon District requirements and determine the necessary battery life.

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C.2.12. Manuals. At least two sets of complete operation and maintenance manuals shall be included with each receiver and shall cover all auxiliary components furnished with each receiver. *[Updates shall be furnished as they become available.]

C.2.13. Field Planning. The receiver shall have internal software that, as a minimum, is capable of computing the availability and positions of satellites for any given time and the current position of the GPS receiver *[and terrestrial position] using data gathered by the GPS receiver.

*[C.2.14. Dimensions. The dimensions of the receiver shall not exceed *[___] length by *[___] width by *[___] height, all such that one person can easily transport the unit.]

*[C.2.15. Weight. The receiver shall be transportable by one person. [One complete field station consisting of receiver, battery pack, antenna, and antenna cable shall not exceed * [___] kg * (__) lbs.]

*[C.2.16. Data Logger. The receiver shall be capable of recording and controlling data on an *[internal]*[external] storage device. This device shall be capable of storing a minimum of *[4] *[6] *[8] *[___] megabytes (mb) of data.]

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NOTE: The DATA LOGGER (C.2.16.) option is required by those who wish to store data within the receiver for post mission processing. Without this capability, some external device, such as a computer and interfacing software, will be required to perform the data logging. Memory should be specified to cover the maximum expected recording durations and rates.

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*[C.2.17. Additional Options for Meter-level DGPS Operations.]

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NOTE: This entire section is optional. It is possible for "geodetic type" GPS receivers as described previously to perform differential code (meter-level) positioning using standard broadcast messages from systems such as the U.S. Coast Guard radio beacon network. If this type of positioning is required, then the following options should be included in the solicitation. Use of the USACE's OTF software does not depend on the following options.

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*[(1) Format. The reference station receiver shall output dgps correction data in the radio technical commission for maritime services special committee 104 (RTCM SC-104) format, version 2.1 and U.S. Coast Guard Broadcast Standard.]

*[(2) Format. The remote station receiver shall accept and apply correction data in RTCMM SC-104 format, version 2.1.]

*[(3) Accuracy. Real time positioning accuracy relative to the reference station shall be *[2] *[6] m *[2] DRMS within a range of at least 42 km (25 miles) from the reference station.]

*[(4) Waypoints. The receivers shall have the ability to accept up to *[___] waypoints which can be selected by the helmsman.]

*[(5) Position Rate. The receiver shall be capable of providing output position fixes at rates within the range of [__] Hz to [__] Hz.]

*[(6) Velocity. The receiver shall be capable of determining *[velocity and] position while moving at speeds of up to [5.14] * [___] meters per sec (*[10] *[___] knots).]

*[C.2.18. Additional Options for Geodetic Grade Static Survey Operations.]

*[(1) Accuracy Specification. The GPS reference receiver shall be capable, when used in conjunction with a remote GPS receiver, of 10 mm + 2 ppm accuracy or better on baselines of 1 to 50 km in length when used in the static differential mode. The receivers shall have an accuracy of 10 mm or better on baselines less than 1 km.]

*[(2) Data Collection. The receiver shall not require over 1 hr of continuous data collection with a minimum of four satellites in order to achieve the accuracy requirements stated in Paragraph C.2.18 (1).]

C.2.19. GPS Antenna Assembly.

(1) Antenna Mount. The GPS antenna shall be capable of being mounted on a standard surveyor's tripod with a 5/8-in. by 11-in. threaded stud *[or to a standard wild type tribrach].

(2) Antenna Phase Center. The center instability of the 3-dimensional phase center of the GPS antenna shall be no greater than 3 mm.

(3) Receiver/Antenna Separation. The system shall allow the antenna to be located at least *[30] *[___] m from the receiver so that it can be operated remotely from the receiver with no system degradation.

(4) Antenna Cables. *[One] *[___] antenna cable(s) shall be furnished with each receiver. *[[One] *[each] of these cables should be at least *[__] m,] * [and the other cable should be at least *[__] m.] All appropriate connectors should already be attached to the cable ends. *[These cables shall be capable of being cascaded for a total length of *[___] m of cable for setup flexibility.]

(5) GPS Survey Antenna. Survey antennas shall receive GPS signals at the l1 *[and l2] frequency *[frequencies] and provide these signals to the GPS receiver. The antenna shall have an omnidirectional horizontal pattern and shall incorporate features which minimize multipath error.

*[(6) Antenna Assembly. The antenna assembly shall include the following items:

*[(a) A method to minimize ice and snow buildup.]

*[(b) A method to reduce bird nesting capability.]

*[(c) The ability to withstand strong winds up to * [___] meters per sec (*[___] knots).]

*[(d) A method to orient (to north) after mounting.]

*[(e) A mechanical mark for height measurement with known offset from phase center.]

*[(f) Operation within the temperature range of -40 ^{o}C to +65 ^{o}C.]

*[(g) Dimensions. The dimensions of the antenna shall not exceed *[45 cm] in length by *[45 cm] in width by *[15 cm] in height, all so that one person can easily transport the unit.]

*[(h) A method to reduce the effects of multipath.]

*[(i) A method to amplify the signal for cable lengths in excess of 15 m.]

*[(7) Each antenna shall be 100 percent sealed/watertight. *[One] *[___] GPS antenna shall be provided with each GPS receiver unit.]

*[(8) Antenna Pole. An antenna pole shall be provided for use during survey operations. It shall be *[a fixed height pole of 2 m] *[extendable from a length of 1 m (±0.2 m) to 2 m (with a variance of ±0.5m)] and shall allow rapid attachment and detachment of the GPS survey antenna. The pole shall include a built-in leveling device and legs which are *[collapsible and attached] *[detachable].]

*[(9) Tribrach. A standard tribrach (with adapters) shall be provided with each antenna. The tribrach shall allow the antenna to be mounted atop the tripod. The tribrach shall be able to be mounted on top of a

standard surveyor's tripod with a 5/8-in. threaded stud and shall include adapters to allow mounting of standard target sets.]

*[(10) Vehicular Antenna Mount. A survey antenna mount shall be provided that can easily be attached or detached from the vehicle. This mount shall be designed so that it remains firmly in place at speeds of up to 88.5 kmph (55 mph) on a level roadway. The mount shall be designed so that its use does not require vehicle modification.]

C.2.20. Input and Output (I/O) Ports.

(1) Standards. All I/O ports will be compatible with the RS-232 standard.

(2) I/O Ports. *[I/O ports shall be compatible with any processor, data terminal, or storage devices used in the positioning system.] *[The vendor shall provide complete documentation of the I/O ports including connector, signal descriptors, connector pin outs, communications protocols, command and message descriptions, need to set up the receiver and extract and decode the observed data.]

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NOTE: The following options [C.2.20(3) and C.2.20(4)] are not required for the OTF system operation. They would be used for differential code position interface to marine systems such as electronic charts or hydrographic survey systems.

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*[(3) Real time positional data out of the remote receiver will adhere to the National Maritime Electronics Association (NMEA) 0183 data sentences format and will be output over an RS-232 compatible port.]

*[(4) The receiver shall have the capability to output the data, position fixes, and calibration data through a RS-232 compatible serial port.]

C.3. Microcomputer Systems. The microcomputer shall be a portable, *[notebook style,] IBM compatible, microcomputer that is fully compatible with all software and hardware supplied under this solicitation. In addition, the following minimum features shall be included:

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NOTE: For operation of the USACE OTF software, one microcomputer is required for each GPS receiver. A notebook style IS HIGHLY recommended.

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C.3.1. Operate with the microsoft disk operating system (MSDOS) version 5.0 or later.

C.3.2. Utilize a *[486] *[pentium] processor.

C.3.3. Have a clock speed of at least *[33] MHz.

C.3.4. Have a minimum of *[250] megabytes of storage capacity on an internal hard drive, with a 20 msec access speed.

C.3.5. Have a minimum *[16] megabyte of random access memory.

C.3.6. Have one 3.5-in. high density disk drive.

C.3.7. Have a VGA graphics adapter.

C.3.8. Be capable of operating from the same power source as the GPS receiver.

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NOTE: The following item, (C.3.9.), is required for the operation of the USACE OTF software and may not be required for any vendor supplied OTF or kinematic procedure.

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*[C.3.9. Have four serial ports that are available for external use after connecting any mouse trackball, or other device included by the computer manufacturer for operating that computer.

(1) The board for the additional serial ports shall have the host addresses starting at 300 hexadecimal and the interrupts slaved to IRQ5.]

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NOTE: Microcomputer and printer requirements must be tailored to existing USACE Command computer resources. Since this item will generally be based in the field, a dual capability may be required in the District office. Refer to EM 1110-1-1003 for additional details on GPS baseline computation and adjustment requirements.

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C.4. GPS Baseline Processing and Reduction Software.

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NOTE: The USACE OTF software may be used to compute 3-dimensional coordinate differences and positions of the "object" station. This software only uses the OTF ambiguity resolution technique, and is not suited for classic "static" GPS applications. This software is suited for kinematic application and will operate in real-time or post mission processing modes. A number of vendors have similar capability.

Based on FOA requirements, baseline processing software or adjustment software may not be a requirement of this solicitation.

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C.4.1. General. The GPS baseline processing software must be fully compatible with the receivers and microprocessors listed in Paragraphs C.2. and C.3.

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NOTE: If the microprocessor is NOT included as part of this solicitation, then the type of processor must be given to verify software compatibility.

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C.4.2. Data Computations. The baseline reduction software shall compute, at a minimum, *[the carrier-phase integer cycle ambiguity using static and kinematic techniques, including those commonly known as "known

baseline," "rapid static," "antenna swap," "stop-and-go," and "OTF"] *[and subsequently] the 3-dimensional differential baseline components between observation stations, within the accuracy specifications given in Paragraph C.1.

C.4.3. Ephemerides. The baselines computations must utilize both the broadcast and precise ephemerides.

C.4.4. Output Data. The results of the baseline processing shall be in any user-selected form, such as *[geocentric coordinates,] *[state plane coordinates based on the North American Datum of 1927,] *[state plane coordinates based on the North American Datum of 1983,] *[and] *[or] *[universal transform mercator projection coordinates].

C.4.5. Batch Processing. The software shall have the capability to post mission process data sets unattended in a batch mode.

C.4.6. Multiple Copies. The Government shall be allowed to operate the software simultaneously on *[_____] microcomputer systems.

C.4.7. Absolute Point Positioning. The software shall be capable of processing pseudo-range data to obtain single point positions of a single receiver.

*[C.4.8. Real-Time Capability. The software shall be capable of resolving carrier cycle integer ambiguities in real time when the observing stations are connected via a communications link *[as specified elsewhere in this solicitation] using the computational procedure given in Paragraph C.4.2., and subsequently compute 3-dimensional differential baseline components.]

*[C.4.9. Real-Time Output. The results of the real-time baseline processing shall be in any user-selected form, such as geocentric coordinates, state plane coordinates based on the North American Datum of 1927, or universal transform mercator projection coordinates. The results will be time tagged with an accuracy of 50 msec, at the time of signal reception at the antenna. The results will be written to a memory device *[both]*[internal and] external to the device performing the computations and shall be sent to an external computer system, at the selection of the user.]

C.4.10. Updates. All baseline processing software updates shall be provided for a period of *[4] years from the date of delivery.

C.5. Network Adjustment Software.

C.5.1. The network adjustment software shall allow for the direct input of data from the post mission processing software specified in Paragraph C.4. The adjustment software shall include routines to easily edit, correct, manipulate, and output results. The software shall have the capability of simultaneously adjusting a minimum of 100 stations. *[The software shall be fully compatible with the microprocessor listed in Paragraph C.3.]

C.5.2. The network adjustment software shall be based on the theory of least squares. It shall be capable of performing both minimally and fully constrained adjustments. Output statistics shall include relative line (distance) accuracies between all points in the network and point confidence limits for each point in the network. Normalized residuals shall be displayed for all input vectors.

C.5.3. The network adjustment software shall transform geocentric coordinates and geographic coordinates to any user defined projection, such as the North American Datum of 1927 state plane coordinate system.

C.5.4. Multiple Copies. The Government shall be allowed to operate the software simultaneously on *[_____] microcomputer systems.

C.5.5. Updates. All baseline processing software updates shall be provided for a period of *[4] years from the date of delivery.

C.5.6. Geoid Modelling. The software shall include the most recent geoid model available to the public from the national geodetic survey.

*[C.5.7. The network adjustment software shall accept and incorporate data from conventional survey methods such as angles, distance, and elevation differences.]

C.6. Data Link for Real-Time Applications.

C.6.1. The data link shall be completely functionally integrated with the receivers and processors procured under this solicitation. This includes the incorporation of modems for the complete interface of radio to processor/receiver.

C.6.2. The data link shall provide data from the reference station to the "roving" station to allow the system to compute positions of the roving station using a kinematic processing technique, as specified in Paragraph C.1. of this solicitation, at a rate of at least one position per second, with no more than one (1) percent loss of position data. The data link equipment shall be identical at both stations to allow transmission from the "roving" station to the reference station. The kinematic processing technique shall not be a function of the data link used. The data link shall transmit all receiver raw observables, as specified in Paragraph C.2. of this solicitation, to the other receiver used in the differential GPS system.

C.6.3. *[The data link system shall operate at the *[VHF frequency of _____]*[VHF frequencies of ___ ___ ___]]. *[The data link shall operate at a frequency that does not require lincensure for use.] *[The data link shall utilize a commercially available carrier phase broadcast that follows the criteria found elsewhere in Section C of this specification. The proposal will include a fee schedule for prescription and monthly service.]

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NOTE: The frequency used for a VHF broadcast must be coordinated with the FOA frequency manager. Modulation rates and/or channel bandwidth requirements also may have to be specified. The unlicensed frequency will also be low power, hence, very short range.

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*[C.6.4. The data link shall have an omnidirectional broadcast range of *[8]*[16]*[24]*[32]*[40] km (*[5]*[10]*[15]*[20]*[25] miles) and maintain the positioning capability stated in Paragraph C.6.2.]

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NOTE: Today, the maximum range of the OTF technology is about 26.6 km (25 miles). Additionally, the longer ranges require increased power, thus, more licensing restriction.

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*[C.6.5. A mounting kit shall be included to mount the data link antenna to a mast or range pole.]

*[C.6.6. The data link antenna shall be *[suitable for installation on small hydrographic survey launches (less

than 7 m)] *[and]*[have an antenna cable of at least *[____] m]].

*[C.6.7. Power Supply. The data link (including modem) shall operate on the same power source as the GPS receiver.]

C.7. Training.

C.7.1. Upon delivery, the vendor shall provide training of at least *[4] days at *[location] *[to *[4] persons] on the operation of all software and hardware delivered as part of this contract.

*[C.7.2. At a future date, determined by the contracting officer based on coordination with the vendor, and not exceeding 6 months after delivery, the vendor will give an additional *[2] days training at *[location].]

C.8. Miscellaneous Requirements.

C.8.1. All power cables, computer cables, and any other item not mentioned in these specifications needed to make this equipment fully operable shall be furnished as part of this contract.

*[C.8.2. Ruggedized shipping containers shall be furnished for all hardware delivered under this solicitation.]

*[C.8.3. Survey Planning. Survey planning software shall be provided that, as a minimum, includes the following items: tabular and graphic satellite rise/set times, elevations, and azimuths for user-specified geographic locations and times; sky plots of SV positions with provisions for plotting satellite obstructions on the screen; listing of DGOP, PDOP, HDOP, and VDOP; and the selection of specific SV constellations to support in-depth kinematic survey planning.

*[C.8.4. All *[hardware]*[and]*[software] updates will be provided to the Government for a period of * [___] years from the date of delivery, free of charge or delivery cost.]

*[C.8.5. The vendor shall provide repair and maintenance of all hardware delivered under this solicitation for a period of *[___ (--)] years, free of charge.]

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NOTE: At this point, other unique items may be added to the requirements if called for and/or requiring specification in Section B. Any specific vessel installation requirements for receivers, data links or antenna should be added. As-built vessel drawings or installation sketches should be attached to the contract at Part III, Section J. If DGPS is to be integrated with an existing navigation and/or survey system, manuals, drawings, etc. associated with that system should be referenced and attached at Section J. Both hardware and software connections and modifications to the existing system must be detailed if such effort is to be an item of work under this contract.

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Section D

Packaging and Marking

D.1. Preparation for Delivery. The system shall be packaged for shipment in accordance with the supplier’s

standard commercial practice.

D.2. Packaging and Marking. Packaging shall be accomplished so that the materials will be protected from handling damage. Each package shall contain a properly numbered, dated, and signed transmittal letter or shipping form, in duplicate, listing the materials being transmitted. Shipping labels shall be marked as follows:

U.S. Army Engineer District, _____
ATTN: {include office symbol and name}
Contract No. _____
[Street/PO Box] {complete local mailing address}

Section E

Inspection and Acceptance

E.1. Acceptance Test. All equipment and related components obtained under these specifications shall be fully certified prior to contract award as meeting the performance and accuracy in Section C. *[Any test previously performed for the Federal Geodetic Control Subcommitee (FGCS) will be acceptable for such certification by the vendor; otherwise the vendor shall be required to demonstrate, at the vendor's expense, the acceptability of the system in the manner prescribed in Paragraph E.2. If the FGCS test is to be used in lieu of a demonstration acceptance test, all results from the FGCS test shall be supplied to the contracting officer for evaluation by technical personnel.]

E.2. Final Acceptance Test. At the option of the Government, a final acceptance test will be performed to demonstrate total system conformance with the technical specifications and requirements in Section C.

E.2.1. The acceptance test will be conducted with the system operating in the modes stated in Paragraph C.1. of this solicitation.

E.2.2. The DGPS positional accuracy will be tested against the accuracy and ranges specified in Paragraph C.1. of this solicitation. The resultant DGPS accuracy will be evaluated with the 1 DRMS error statistic. Inaccuracies in the comparitive testing network / system will be properly allowed for in assessing the test results.

E.2.3. Final acceptance testing will be performed at *[the point of delivery indicated in Section D] *[_____], and will be performed within *[____] days after delivery. The supplier will be notified of the results within *[____] days after delivery. If the equipment fails to meet the acceptance test(s), the supplier will be given *[____] days after notification thereof to make any modification(s) necessary to enable retesting. The supplier will be notified of the place, date, and time of testing and, at his option, may send a representative to attend such tests.

E.2.4. If after a second test, the system fails to perform in accordance with the technical specifications, the Government will *[_____].

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NOTE: The applicable contract clause and provisions must be referenced here.

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E.3. Warranty Provisions. For 1 year after delivery by the vendor, all equipment failures, other than those due to abuse, shall be corrected free of charge. Equipment shall be repaired within 5 working days of receipt at the repair facility, or loaner equipment will be provided at no expense to the Government until repairs are completed and the equipment has been returned to the district. The cost of shipping equipment to the vendor for repair shall be paid by the Government while the vendor will pay for returning the equipment to the District.

Section F

Deliveries or Performance

F.1. Delivery and final acceptance of all equipment shall be made within *[___] days after contract award. Delivery shall be made at the USACE facilities at the address identified in Paragraph D.2. of this solicitation. Final acceptance will depend upon all equipment meeting all requirements specified in this contract.

F.2. The contractor shall deliver all material and articles for shipment in a manner that will ensure arrival at the specified delivery point in satisfactory condition and that will be acceptable to carriers at the lowest rates. The contractor shall be responsible for any and all damage until the equipment is delivered to the Government.

Section G

Contract Administration Data

Section H

Special Contract Requirements

Part II - Contract Clauses

Section I - Contract Clauses

Part III - Contract Clauses

Section J - List of Documents, Exhibits, and Other Attachments

Part IV - Representations and Instructions

Section K - Representations, Certifications, and Other Statements of Bidders

Section L - Instructions, Conditions, and Notices to Bidders

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NOTE: Add applicable contract clauses and provisions to the above parts/sections as required by the FAR and other supplemental regulations.

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Part IV - Representations and Instructions

Section M - Evaluation Factors for Award

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NOTE: The following clauses would be used if the solicitation requires an evaluation of proposals for award. See the introduction to this guide for the necessity of a formal proposal evaluation.

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M.1. Price Basis. Bidders are advised that all bids are solicited on a firm fixed-price basis, and bids submitted on any other than a fixed-price basis will be rejected. Bids submitted on a basis other than free on board (FOB) destination will be rejected.

M.2. Evaluation Criteria.

M.2.1. Technical Factors. The technical part of the proposal shall clearly and fully describe the system to be furnished. Descriptive literature, manuals, and/or reports supplied by the Offeror will be the basis of the evaluation. They should clearly address all items found in the specifications. It is imperative that the Offeror respond to all items in the specifications in like language so the evaluation will compare all products from a common standard. Simple statements such as "conform", which indicate understanding of the requirements, are not adequate. Similarly, phrases which imply or state that the product meets or exceeds the specifications without providing adequate data for the evaluators to make comparisons with those specifications are not adequate.

M.2.2. Pricing Factors. The Offeror shall submit a lump sum firm-fixed-price in accordance with Part I, The Schedule, Section B.

M.2.3. Preliminary Assessment Procedure. A preliminary assessment will be performed to determine if the Offeror’s proposal is acceptable or can be made acceptable without major modification.

M.2.4. Evaluation Procedure. The evaluation will be based on the Offeror’s compliance with a set of technical requirements consisting of the following items:

(1) System Operational Characteristics and Capacities. This includes, but is not limited to, accuracy, number of independent channels, kinematic capability, data link system performance, ease of operation, and versatility.

(2) System Physical Characteristics and Capacities. This includes, but is not limited to, weight, energy requirements, ease of use, and protection from the environment.

(3) *[Post processing software,] *[network adjustment software,]*[and] field planning software. This includes, but is not limited to, adequacy of software for the specified task, ease of use, documentation, versatility, graphics capabilities, and support.

(4) Warranty, support services, and miscellaneous items.

(5) Proposals will be evaluated on the factors listed above by having assigned values that contribute to a total score. Baseline values will be established by the criteria found in the specifications. Weighting of the scores is in descending order of the above factors, with the most important listed at the top and the least important listed last. A technical team will evaluate each technical proposal and assign a point score. For those proposals that do not meet a pre-established minimum score as submitted, but which the Government decides could be made acceptable by the submission of more information, technical discussions may be conducted to obtain clarification or enhancement of any such proposals. After these discussions, a final point score will be assigned to each proposal by the team.

M.2.5. Proposal Completeness. Failure to submit all required information will result in the proposal not being evaluated.

M.2.6. Number of Technical and Price Proposals. *[One] technical and *[one] cost proposal(s) shall be submitted by each Offeror.

M.2.7. Final Acceptance Test. The system (equipment and/or software) may be required to undergo a final field acceptance test as described in Section E of this contract. Final award shall be contingent on this acceptance test.

M.3. Award Procedures.

M.3.1. The Government will select for contract award the best overall proposal whose final offer is the most advantageous to the Government considering the price and the technical factors included in the solicitation.

M.3.2. The Government may award a contract on the basis of initial offers received, without discussions. Therefore, each initial offer should contain the Offeror's best terms from a cost or price and technical standpoint.

M.4. Suggested Proposal Submittal Requirements.

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NOTE: The following is a list of hardware and software items/options that should be provided by bidders to determine their capability of providing an adequate DGPS-based positioning system. These items should be tailored to specific system requirements as developed in Section C of this solicitation, and would be used only when technical proposals are being evaluated.

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M.4.1 GPS Receivers.

Signal levels .
Operation without cryptographic keys.
Observables.
    Measurement time tags.
    Carrier phase signals and accuracy.
    Code phase signals and accuracy.
Receiver output.
Receiver data rate.
PPS output.
Internal receiver testing.

Reinitialization.
Multiple satellite tracking.
Operating conditions.
5 deg SV acquisition.
Humidity range.
Temperature range.
Waterproof.
Corrosion resistance.
Power requirements.
Surge protection.
Power transfer from AC to DC and reverse.
Low power warning.
External power source.
Battery pack.
Charge/recharge capacity.
Battery connections/cables.
Manuals.
Field planning software.
Dimensions.
Weight.
Data logging device.
RTCM output.
RTCM input.
Waypoints.
Position update rate.
Velocity output.
Antenna.
5/8-in. by 11-in. mounting.
Phase center stability.
Cable length and quantity.
Frequency reception.
Environmental considerations.
Waterproof.
Antenna pole.
Tribrach.
Vehicle mount.
Input/Output ports.
RS-232 standard.
Compatability with other components.
NMEA position string.
Serial port.

M.4.2. Microcomputer Systems.

Software/hardware compatibility.
DOS operating system.
Processor chip.
Clock speed.
Hard drive capacity and access speed.

Random access memory.
3.5-in. disk drive.
VGA graphics adapter.
Power source.
Four extra serial ports (in addition to a mouse port).

M.4.3. Baseline Processing Software.

Compatibility with receivers and microcomputers.
Data computations.
Ephemerides.
Output data.
Batch processing.
Multiple copies.
Absolute point positioning.
Real-time output.
Updates.

M.4.4. Network Adjustment Software.

Compatibility with other software supplied.
100 station minimum.
Theory of Least Squares.
Transformation capability.
Multiple copies.
Updates.
Conventional survey data input.

M.4.5. Data Link for Real-Time Application.

Compatibility with receivers and microcomputers.
1-sec update rate.
Transmission of raw observables.
Frequency.
Broadcast range.
Data loss (less than 1 percent).
Mounting kit.
Power supply.

M.4.6. Training.

At delivery.
At future date.

M.4.7. Miscellaneous Requirements.

Cables, etc.
Shipping containers.
Survey planning software.

Hardware and software updates.
Maintenance and repair.